ER 55 – Electrician Regulations Answer Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

Question 1	*Marks*	*Reference*	*Marking notes*
(a) • The unearthed conductive parts of fittings are separated from live parts by no more than basic insulation • The fitting is intended to have, or is supplied as having, a safety function, but does not in fact serve that safety function.	(2 marks)	ESR 22	
(b) Any TWO of:	(2 marks)		
• The certificate must be signed and dated by the person who did the connection.		ESR 74A(3)(f)(i)	
• The certificate must be signed and dated by the supervisor if the person who did the connection was acting under supervision.		ESR 74A(3)(f)(ii)	
• The supervisor must state their registration number		ESR 74A(3)(g)(iii)	
(c) Any ONE of:	(2 marks)		
• Other circuits including submains and final subcircuits supplying fixed or stationary equipment		AS/NZS 3000 1.5.5.3(d)(ii)	
• Other circuits where it can be shown that people are not exposed to touch voltages that exceed safe values.		AS/NZS 3000 5.7.2(b)	
• For circuits not directly supplying portable or hand-led equipment		AS/NZS 3000 B4.3	
(d) • Every electrical installation shall be divided into circuits as necessary to avoid danger and to minimise inconvenience in the event of a fault.	(1 mark)	AS/NZS 3000: 1.6.5(a)	Answers can be also sourced from: • 1.6.1 (d), (e) • 2.2.1.1(c), (d) • Figure B1 Notes (c) and (e)
• Every electrical installation shall be divided into circuits as necessary to facilitate safe operation, inspection, testing and maintenance.	(1 mark)	AS/NZS 3000: 1.6.5(b)	

Question 1	*Marks*	*Reference*	*Marking notes*
(e) • Shall be selected and installed provide additional protection against electric shock in locations where the presence of water or high humidity presents and increased risk	(1 mark)	AS/NZS 3000 1.7.4(b) 6.1.2(a)	
• Shall be selected and installed to provide adequate protection against damage that might reasonably be expected from the presence of water or high humidity	(1 mark)	AS/NZS 3000 1.7.4(b) 6.1.2(b)	
(f) Any ONE of:	(2 marks)		
• Suitable protective measures shall be taken where – (a) the loss and subsequent restoration of voltage; or. (b) a drop in voltage; could cause danger to persons and property.		AS/NZS 3000: 2.8.1	
• Where unexpected restarting of a motor might cause danger, each electric motor shall be provided with a means to prevent automatic restarting after stopping		AS/NZS 3000: 4.13.1.4	
(g) Any TWO of:	(2 marks)		
• All equipment shall be legibly and indelibly identified in the English language.		AS/NZS 3000 2.9.5.1	
• The relationship of switches, circuit breakers, fuses, RCDs and similar electrical equipment to various sections of the electrical installation shall be marked on or adjacent to the switchboard		AS/NZS 3000 2.9.5.2	
• The means of identification should be adequate to enable persons to readily identify equipment supplied and the corresponding circuit protective device		AS/NZS 3000 2.9.5.2	
• Bars and links shall be identified to indicate whether they are active, neutral or earth.		AS/NZS 3000 2.9.5.3	
• Terminals of bars, links, circuit-breakers, fuses and other electrical equipment mounted on a switchboard shall be marked or arranged to identify the corresponding active and neutral connections for each circuit.		AS/NZS 3000 2.9.5.4	

Question 1	*Marks*	*Reference*	*Marking notes*
• The terminal of the connection of the MEN connection and for the main neutral conductor shall be legibly and indelibly marked at the main neutral bar or link		AS/NZS 3000 2.9.5.4	
• Where a common neutral is used for two or more different circuits it shall be legibly and permanently marked to identify the associated active conductors.		AS/NZS 3000 2.9.5.5	
• Where the marking of a fuse base does not correctly indicate the rating of the associated fuse element, the rating of the fuse element shall be marked either on an exposed non-detachable portion of the fuse or on its enclosing case or on the switchboard adjacent to the fuse.		AS/NZS 3000 2.9.565	
(h) Any TWO of: • Sprinkler pipes • Pipes conveying gas • Pipes conveying water • Pipes conveying flammable liquid • Other conductive non-electrical service enclosures		AS/NZS 3000 5.3.2.2	
(i) • Precautions shall be taken to ensure the safety of persons	(1 mark)	AS/NZS 3000: 8.1.2 1.8	
• And to avoid damage to property and the electrical installation equipment.	(1 mark)	AS/NZS 3000: 8.1.2 1.8	
(j) Any ONE of:	(2 marks)		
• All electrical installations and any alterations, additions and repairs to electrical installations shall, prior to be placed into service or use, be inspected as far as practicable and tested to verify that the installation meets the requirements of this Standard as applicable.		AS/NZS 3000: 1.8	
• Prior to placing an electrical installation or any part thereof, in service following construction, alteration, addition or repair thereof, it shall be verified, as far as practicable, that the installation is safe to energise and will operate correctly in accordance with the		AS/NZS 3000: 8.1.2	

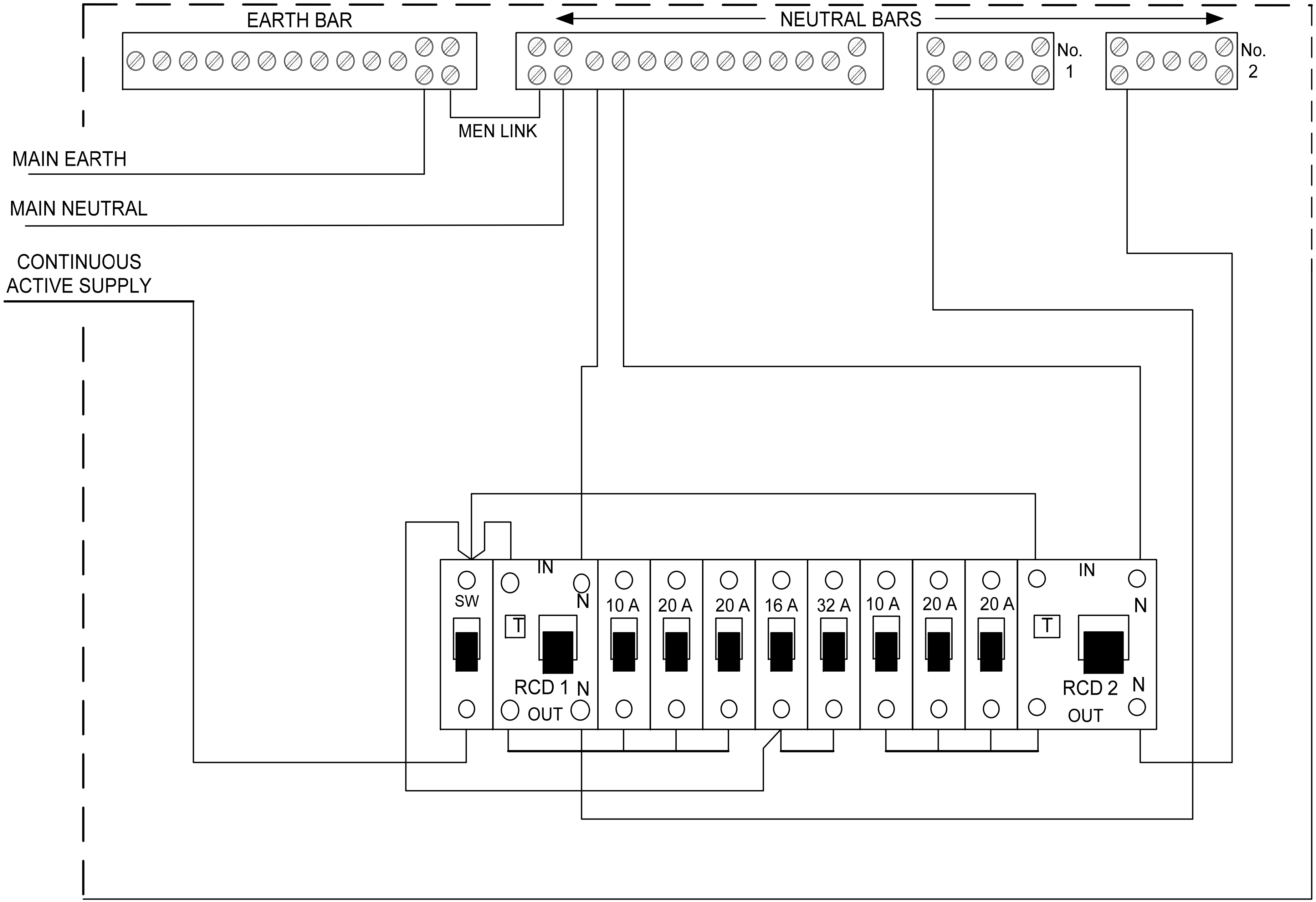
Question 1	*Marks*	*Reference*	*Marking notes*
requirements of this Standard. - The alterations and additions comply with AS/NZS 3000. - The alterations and additions do not impair the safety of the existing electrical installation - A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of this Standard - After completion of, or in association with, the visual inspection, tests in accordance with clause 8.3.3, shall be carried out on the electrical installation to verify that it complies with the requirements of this Standard and that its suitable for the use intended		AS/NZS 3000: 8.1.2 AS/NZS 3000: 8.1.2 AS/NZS 3000: 8.2.1 AS/NZS 3000: 8.3.1	

Question 2	*Marks*	*Reference*	*Marking notes*
(a) Any ONE of:	(1 mark)		
• The fittings are impaired		ESR 20(2)(a)	
• Fittings are installed in such a way that any designed cooling conditions are impaired.		ESR 20(2)(e)	
• Fittings that cause or are subject to high temperatures are placed in such a position so as to create a source of ignition.		ESR 20(2)(f)	
• There is insufficient space, access and lighting to operate, maintain, repair, test or inspect the fittings in a safe manner		ESR 20(2)(i)	
(b) • They shall operate directly in the circuit wiring to the heater elements.	(1 mark)	AS/NZS 3000 4.8.2.2(a)	
• Not to be arranged for control through relays or contactors.	(1 mark)	AS/NZS 3000 4.8.2.2(b)	
(c) Any TWO of:	(2 marks)		
• Shall be provided with a switching device that operates in all live (active and neutral) conductors.		AS/NZS 3000: 4.7.1	
• The switch shall be mounted near the appliance in a visible and readily accessible position.		AS/NZS 3000: 4.7.1 4.18.1	
• Switches shall be marked to identify the appliance controlled.		AS/NZS 3000: 4.7.1	
• The switch should be mounted within two metres of the cooking appliance.		AS/NZS 3000: 4.7.1 Note 1	
• It is recommended that switches be marked to identify the appliance controlled		AS/NZS 3000: 4.7.1 Note 3	
(d) The free-standing cooking appliance shall be connected to the electrical installation wiring by a socket-outlet or an installation coupler	(1 mark)	AS/NZS 3000: 4.7.2 4.18.1	
(e) • Direct connection	(½ mark)	AS/NZS 3000 4.3.2.1	
• Installation coupler connection	(½ mark)	AS/NZS 3000 4.3.2.2	
• Socket outlet	(½ mark)	AS/NZS 3000 4.3.3	

Question 2	*Marks*	*Reference*	*Marking notes*
• Other connecting devices (e.g., ceiling rose or permanent connection unit	(½ mark)	AS/NZS 3000 4.3.4	
(f) • The switch rating shall not be less than the total current rating of the socket outlets. • The switch rating shall not be less than the current rating of the overcurrent protective device on the circuit.	(1 mark) (1 mark)	AS/NZS 3000: 4.4.4.2(a) AS/NZS 3000: 4.4.4.2(b)	

Question 3		*Marks*	*Reference*	*Marking notes*
(a)	• The switchboard is provided with a suitable enclosure	(½ mark)	AS/NZS 3000 2.9.2.5(b) Exception	
	• The switchboard is installed in a cupboard with close-fitting doors.	(½ mark)	AS/NZS 3000 2.9.2.5(b) Exception	
(b)	• MEN Link	(½ mark)		(See diagram)
	• A neutral conductor between the main neutral bar to the "in" neutral terminal of RCD 1	(½ mark)		
	• A neutral conductor between the "out" neutral terminal of RCD 1 and neutral bar 1	(½ mark)		
	• A neutral conductor between the main neutral bar to the "in" neutral terminal of RCD 2	(½ mark)		No MEN link installed – no marks for (b)
	• A neutral conductor between the "out" neutral terminal of RCD 2 and neutral bar 2	(½ mark)		
	• An active conductor from the load side of the main switch to the "in" active terminal of RCD 1	(½ mark)		
	• An active conductor from the "out" active terminal of RCD 1 to the supply side of one 10A MCB and two 20A MCBs	(½ mark)		
	• An active conductor from the load side of the main switch to the "in" active terminal of RCD 2	(½ mark)		
	• An active conductor from the "out" active terminal of RCD 2 to the supply side of one 10A MCB and two 20A MCBs	(½ mark)		
	• An active conductor from the load side of the supply side of the 16A MCB	(½ mark)		
	• An active conductor from the load side of the supply side of the 32A MCB	(½ mark)		
(c)	• The main phase (active) conductor correctly terminated	(½ mark)		
	• The main neutral conductor correctly terminated	(½ mark)		
	• The main earthing conductor correctly terminated	(½ mark)		
(d)	Any TWO of:	(2 marks)		
	• There is one lighting circuit on each RCD.			

Question 3	*Marks*	*Reference*	*Marking notes*
Ref: AS/NZS 3000: 2.6.2.4(a) ● There are 3 final subcircuits on each RCD. Ref: AS/NZS 3000: 2.6.2.4(b) ● Fixed wired appliances do not require RCD protection Ref: AS/NZS 3000: 2.6.3.1(c) Or GK			This is more by exclusion. If the fixed wired appliance is not hand-held, then no RCD protection is required


EARTH BAR
NEUTRAL BARS
No. 1
No. 2
MEN LINK
MAIN EARTH
MAIN NEUTRAL
CONTINUOUS ACTIVE SUPPLY
SW
IN
N
T
RCD 1
N
OUT
10 A
20 A
20 A
16 A
32 A
10 A
20 A
20 A
IN
N
T
RCD 2
N
OUT

Question 4	*Marks*	*Reference*	*Marking notes*
(a) Any TWO of: ● Enable automatic disconnection of supply in the event of a short-circuit to earth fault or excessive earth leakage current in the protected part of the installation through protective earthing arrangements. ● Enable equipment requiring an earth reference to function correctly through functional earth arrangements. ● Mitigate voltage differences appearing between exposed conductive parts of equipment and extraneous conductive parts through equipotential bonding arrangements. ● Provide an effective and reliable low impedance fault path capable of carry earth fault and earth leakage current without danger or failure. ● Provide measures for the connection of exposed conductive parts and extraneous conductive parts.	(2 marks)	AS/NZS 3000: 5.1.2	
(b) ● It limits the touch voltage to safe levels under fault conditions, ● By ensuring automatic disconnection of supply occurs.	(1 mark) (1 mark)	AS/NZS 3000: 5.2.1 AS/NZS 3000: 5.2.1	Clause 5.2.1(b) is an alternative answer to these two bullet points
(c) (i) It is used for the correct operation of equipment. (ii) No colour is stated, but green or green/yellow conductor identification should not be used.	(1 mark) (1 mark)	AS/NZS 3000: 5.2.2 AS/NZS 3000: 5.2.2	
(d) ● The conductor resistance shall not be greater than that for a copper earthing conductor ● The degree of corrosion shall not be inferior to other material suitable for the purpose.	(1 mark) (1 mark)	AS/NZS 3000: 5.3.2.1.3 AS/NZS 3000: 5.3.2.1.3	

Question 4	*Marks*	*Reference*	*Marking notes*
(e) Any FOUR of: ● Has not less than seven strands ● Is support by means of suitable anchorages. ● Has a nominal cross-sectional area of not less than 8.5mm^2 ● Has a resistance in accordance with the requirements of clause 5.3.3 ● Is identified as an earthing conductor at each anchorage point or catenary support.	(2 marks)	AS/NZS 3000: 5.3.2.3(d)	

Question 5	*Marks*	*Reference*	*Marking notes*

Equipment	**Load Group**	**Calculation**	**Load (Amps)**	
60W lights	A(i)	16 points		
100W lights	A(i)	17 points		
6 metres of lighting track	A(i)	2 x 6 = 12 points		
		16 + 17+12 = 45 points		(½ mark)
		3 + 2 + 2 = 7	7.00	(1 mark)
3000W outside lights	A(ii)	(3000 ÷ 230) x 0.75		(½ mark)
			9.78	(1 mark)
15 10A double socket outlets	B(i)	30		
10 10A single socket outlets	B(i)	10		
2 10A single socket outlets	B(i)	2		
		10 + 5 + 5 = 20		(½ mark)
			20.00	(1 mark)
12kW range	C			
		(12000 ÷ 230) x 0.5		(½ mark)
			26.09	(1 mark)
3KW air conditioner	D	(3000 ÷ 230) x 0.75		(½ mark)
			9.78	(1 mark)
4KW instantaneous water heater	E	(4000 ÷ 230) x 0.333		(½ mark)
			5.79	(1 mark)
Total Maximum Demand			78.44	(1 mark)

AS/NZS 3000
Table C1

Note: A total in the range 76A to 80A is acceptable

Question 6	*Marks*	*Reference*	*Marking notes*
(a) Any TWO of: - To ensure that no shock hazard arises from the incorrect connection of active, neutral and earthing conductors - To prevent the transposition of active and neutral conductors of the consumers mains or submains (with MEN connection at outbuilding or detached portion) resulting in the electrical installation earthing system becoming energized - To prevent combinations of incorrect active, neutral and earthing conductor connections resulting in the exposed conductive parts of the electrical installation becoming energized; and - To prevent the connection of switches in neutral conductors, resulting in parts of appliances, such as heating elements and lampholders, remaining energized when the switches are in the 'OFF' position. - To prevent multi-phase equipment, such as multi-phase motors, and semiconductor controlled equipment operating in an unpredictable manner.	(2 marks)	AS/NZS 3000: 8.3.7.1	
(b) (i) - Voltage tester	(½ mark)	GK	
- Temporary earth electrode	(½ mark)	GK	
- Trailing (or flying) lead	(½ mark)	GK	
(ii) The test method has to show:			
- Installing the remote earth and connecting the trailing lead to it	(½ mark)	GK	No marks for (b)(ii) if the MEN link is removed
- Taking a voltage test between the supply side of the main switch and the trailing lead/remote earth.	(1 mark)	GK	
- Taking a voltage test between the earth neutral bar and the trailing lead/remote earth	(1 mark)	GK	

Question 6	*Marks*	*Reference*	*Marking notes*
(iii) • The reading at the main switch should be about 0 V	(1 mark)	GK	
• The reading at the neutral/earth bar should be about 230 V.	(1 mark)	GK	
(iv) • The reading at the main switch should be about 230 V	(1 mark)	GK	
• The reading at the neutral/earth bar should be about 0 V.	(1 mark)	GK	

Question 7	*Marks*	*Reference*	*Marking notes*
(a) (i) To verify that the RCD operates to disconnect the designated circuit.	(1 mark)	AS/NZS 3000: 8.3.10.2	
(ii) • Operation of the integral test device provided that manufacturer's compliance documentation and equipment markings confirm that the RCD is intended to operate under residual alternating current and residual pulsating direct current conditions.	(1 mark)	AS/NZS 3000: 8.3.10.2(a)	
• Use of test equipment which causes the device to operate under residual alternating current and residual pulsating direct current conditions; or	(1 mark)	AS/NZS 3000: 8.3.10.2(b)	
• A suitable test could be performed using a test plug with a resistor between the active and earth pins.	(1 mark)	AS/NZS 3000: 8.3.10.2 Note 3	
(b) • The insulation test result of 1 MΩ was obtained on the entire electrical installation, but with the two water heating cylinders disconnected.	(1 mark)	GK AS/NZS 3000: 8.3.6.2	
• The sheathed heating elements of both water testing cylinders each had a minimum insulation resistance test of at least 10 000 ohms.	(1 mark)	GK AS/NZS 3000: 8.3.6.2	
(c) (i) Any ONE of:	(2 marks)		
• Automatic disconnection of the supply on the occurrence of a fault likely to cause a current flow through a body in contact with exposed conductive parts, where the value of that current is equal to or greater than the shock current.		AS/NZS 3000: 1.5.5.2(a)	
• It is intended to prevent a person being subjected to a dangerous touch voltage for a time sufficient to cause organic damage, in the event of an insulation fault.		AS/NZS 3000: B4.2 1.5.5.3(a)	
• Protection by means of		AS/NZS 3000:	

Question 7	*Marks*	*Reference*	*Marking notes*
automatic disconnection of supply is intended to limit the prospective touch voltage arising between simultaneously accessible conductive parts in the event of a fault between a live part and exposed conductive parts or a protective earthing conductor.		2.4.2	
● In the event of such a fault the circuit protective device must interrupt the resulting fault current sufficiently quickly to prevent the touch voltage persisting long enough to be dangerous		AS/NZS 3000: 5.2.1	
(ii) Any ONE of:	(2 marks)		
● The method of protection shall be achieved by: * provision of a system of equipotential bonding in which exposed conductive parts are connected to a protective earthing conductor * disconnection of the fault by a protective device.		AS/NZS 3000: 1.5.5.3(a)(i), (ii)	
● The protection shall be achieved by: * provision of a system of earthing in which exposed conductive parts are connected to a protective earthing conductor in accordance with section 5 * disconnection of the fault by an overcurrent protective device or an RCD.		AS/NZS 3000: 2.4.2 (a), (b)	

Question 8	*Marks*	*Reference*	*Marking notes*
(a) (i) Any FOUR of: ● Fixed-wired and connected through a continuous flexible cord to a supply of electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts ● The appliances is supplied with electricity from a monitored earth circuit where the supply to the appliance is automatically disconnected if the earth to the appliance is broken or disconnected. ● The appliances are supplied with electricity through an RCD. ● The appliances are supplied with electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts.	(2 marks)	ESR 89 (2)(a),(c), (e) and (f)	
(ii) Any TWO of the following relating to what the candidate has stated in (a)(i): ● The appliance is operating on an isolated supply which has no reference to earth hence no potential to earth. ● The earth wire continuity is continuously being monitored and will disconnect the appliance when the earth fails. ● The earth leakage current is continuously being monitored by RCD and will disconnect the appliance when earth leakage rises above a pre-determined level. ● The appliance is operating on a isolated supply which has no reference to earth hence no potential to earth	(4 marks)		
(iii) 250V	(1 mark)	ESR 88(2)	

Question 8	*Marks*	*Reference*	*Marking notes*

(b)

AS/NZS 3112

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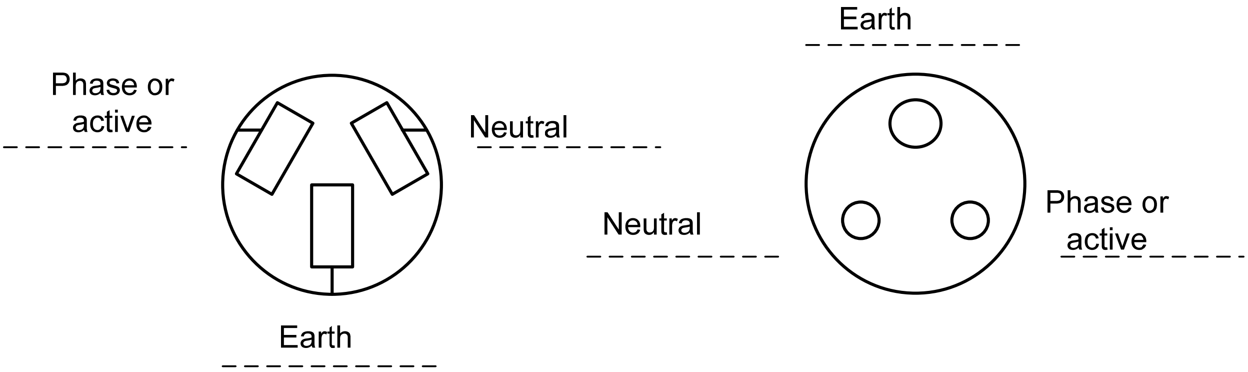

1½ marks for each correct socket outlet	(3 marks)		For each socket, all labels must be fully correct to gain the marks

Question 9	*Marks*	*Reference*	*Marking notes*
(a) (i) • 7%	(½ mark)		
• AS/NZS 3000: 3.6.2, exception 3	(½ mark)		
(ii) Percentage voltage drop permitted = 7 - 2 = 5%	(½ mark)		
Vd @ 400V = 400 x 0.05 = 20V	(½ mark)		
Vd @ 230V	(½ mark)		
= $\frac{20}{\sqrt{3}}$ = 11.55V	(1 mark)		
(b) Luminaire starting current 70W = 0.63A Luminaire starting current 250W = 1.9A Vd for each section of cable, commencing at the switchboard mV/A.m = $\frac{V_d \times 1000}{A \times m}$	(½ mark)		
Vd = $\frac{mV/Am \times A \times L}{1000}$	(½ mark)		
Vd4	(½ mark)		
= $\frac{(1.9 + 0.63) \times 18.02 \times 30}{1000}$ 1.37V	(1 mark)		
Vd5	(½ mark)		
= $\frac{1.9 \times 18.02 \times 30}{1000}$ = 1.03V	(1 mark)		
Total Vd	(½ mark)		
= 3.19 + 2.05 + 1.71 +1.37 +1.03 = 9.35V	(1 mark)		
(c) • Yes	(½ mark)		

Question 9	*Marks*	*Reference*	*Marking notes*
• Because the total volt drop permitted is 11.55V	(½ mark)		